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DELIVERABLE: FINAL REPORT - PHMR CONSOLIDATION OF RZ AND THE IMPLEMENTATION OF THE ECONOMIC DIVERSIFICATION PROGRAM

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The author's views expressed in this publication do not necessarily reflect the views of the United States Agency for International Development or the United States Government.

Contents

1. LIST OF ACRONYMS

FAO	Food and Agriculture Organization
GOB	Government of Belize
GUZ	General Use Zone
MPA	Marine Protected Area
NGO	Non-Government Organization
NTZ	No Take Zone – Old SI
PPC	Placencia Producers Cooperative
PHMR	Port Honduras Marine Reserve
RZ	Replenishment Zone – new zones (2013 onwards)
SI	Statutory Instrument
TIDE	Toledo Institute for Development and Environment
TNC	The Nature Conservancy
TPPL	TIDE Private Protected Lands

2. EXECUTIVE SUMMARY

An ecosystem approach to fisheries management strives to balance diverse societal objectives by taking into account the knowledge and uncertainties about biotic, abiotic and human components of ecosystems and their interactions and applying an integrated approach to fisheries within ecologically meaningful boundaries (FAO definition). It is with this integrated approach in mind that USAID MAREA program has supported The Nature Conservancy in partnership with the Toledo Institute for Development and Environment (co-managers of Port Honduras Marine Reserve) to introduce critical management interventions to the fisheries in the Port Honduras Marine Reserve in Southern Belize. Two of the main aspects of this approach are considered within the scope of this project; they are the 'Increase of Fisheries Replenishment Zones' and the support for 'Supplemental or diversified livelihoods' for coastal communities impacted by marine protected areas. While these approaches may seem distant from each other they ultimately contribute to the overall goal of sustainable management of the fisheries.

3. INTRODUCTION

An ecosystem approach to fisheries management strives to balance diverse societal objectives by taking into account the knowledge and uncertainties about biotic, abiotic and human components of ecosystems and their interactions and applying an integrated approach to fisheries within ecologically meaningful boundaries (FAO definition). It is with this integrated approach in mind that USAID MAREA program has supported The Nature Conservancy in partnership with the Toledo Institute for Development and Environment (co-managers of Port Honduras Marine Reserve) to introduce critical management interventions to the fisheries in the Port Honduras Marine Reserve in Southern Belize. Two of the main aspects of this approach are considered within the scope of this project; they are the 'Increase of Fisheries Replenishment Zones' and the support for 'Supplemental or diversified livelihoods' for coastal communities impacted by marine protected areas. While these approaches may seem distant from each other they ultimately contribute to the overall goal of sustainable management of the fisheries.

4. BACKGROUND

a. Fisheries Replenishment Zones

Marine Protected Areas and Fisheries Replenishment Zones are considered to be some of the most effective tools used to sustainably manage marine fishery in Belize and in other parts of the world. Adequate RZs has the ability to restock fisheries populations in managed areas but they need to be at least 20% of the MPA. Population and growth of queen conch (*Lobatus gigas Linnaeus*, 1758) in the Sapodilla Cayes Marine Reserve of Belize (*Isani Chan1, Li-Chun Tseng1, Hans-Uwe Dahms2 and Jiang-Shiou Hwang1*) indicated that the densities of juveniles and adult conchs in the conservation zone (Fisheries Replenishment Zone) were substantially higher (20.13 and 2.88 individuals/100 m2, respectively) than in the general use zone (5.29 juveniles and 0.58 adults individuals/100 m2). PHMR Benthic Commercial Species Audit 2009---2013 --- Foley & Smith 2013 – TIDE, concluded that the RZs in PHMR, although small (5%) showed some signs of their ability to replenish the general use zones of the marine reserve in times of good compliance, at least in the areas near the RZs. The ideal size of the zone would have to be closer to 20% of the reserve for it to be effective in replenishing the general use zones.

The Belize *Coastal Zone Management Authority and Institute, 2014* stated that 'Currently fishery replenishment zones, also known as "no-take" zones, represent about 3% of Belize's territorial sea. Although they incorporate five key habitat types (coral reef, open sea, seagrass, sparse algae/sand, and mangrove/littoral forest), the effectiveness of these "no-take" zones in replenishing fisheries stocks and enabling the recovery of damaged or degraded ecosystems is limited in part by their small size and fragmented nature. Their effectiveness is also limited by the mobility of many species of fisheries concern and the effects of both proximate and distant pressures, including poor land-use practices and climate change. Expansion of protected zones that prohibit extraction of fish – and, quite possibly, other extractive activities – is essential to enhancing the prospects for success of the country's MPA and broader fisheries and marine habitat management. For several years, the Belize Fisheries Department and several NGOs have been collaborating to expand "no-take" zones within the country's existing marine reserve system while also undertaking technical analyses and other activities aimed at setting priorities for "no-take" zones beyond these marine reserves. These actors have now committed to collaborate on a national "no-take" expansion program for Belize'.

TIDE, as an actor in the national effort started the process of consultation in PHMR over 5 years ago has been able to continue with funding from MAREA program, with various stakeholders of the PHMR and preliminary agreements have been reached for the expansion/consolidation of the current fragmented RZs.

b. Supplemental or Diversified Livelihoods in Coastal Communities

Much of the world's coastal population is living in poverty. Whilst it is recognized that the poor do not cause the most environmental degradation, it is also acknowledged that poverty can force people to use resources unsustainably (*DFID 2002*). Whilst many of the world's coastal poor depend on the natural environment to sustain their livelihoods they are unable to derive an adequate livelihood and continue to remain in poverty. Alternative livelihoods in this situation are seen as a solution to combat poverty by providing alternative means of deriving an income (*DFID 2002*). This project, aims to diversity or supplement the income for the fishermen of Punta Gorda Town while maintaining their connection to the sea. Many times alternative livelihoods projects fail because the project tries to remove fishermen from the sea and introduce unconventional means of obtaining an income. Based on the ongoing work of the USAID regional program with fishers it has been observed that fishermen are open to diversifying their means of income; however they would much prefer to be at sea where they are much more comfortable. The challenge for us was to identify viable supplemental livelihood projects that keep fishermen fishing or maintain their connection to the marine environment.

In Belize, one of the most recent promising enterprises that involve the use the marine environment is seaweed farming. Seaweed is mainly consumed as a base for mixed drink with other local spices and milk. It is locally acclaimed that seaweed has high nutritional value and even anti-cancerous properties but this has not been tested on humans. *Eucheuma isiforme* (seaweed species farmed in PHMR) is a known local ingredient for families and restaurants in drinks, cakes, and breads, and as a vegetable. It is most popularly blended into a cold shake. Some claim it is a natural medical remedy for glaucoma, menopause, arthritis, and tuberculosis, as well as fatigue, headaches, and colds. Purported aphrodisiac and sexually restorative properties contribute to the popularity of *Eucheuma isiforme* and led to its overexploitation in the 1980's.

Many species of seaweed including E. isiforme are high in iron, beta carotene, fiber and other trace minerals (Wikipedia).

There is a high demand for most edible seaweeds in the Asian markets where seaweeds have been used for centuries for medicinal purposes. Our research indicates that Belize is not currently an exporter of seaweed to Asian markets, but most of the seaweed is consumed locally as a cold shake.

5. ACTIVITY SUMMARY

a. RZ consolidation within PHMR

After months of consulting with the PHMR stakeholders including fisheries department, tour guide association , NGOs, and fishers , there was an agreement with Fishers to a consolidation of some of the current fragmented RZs. Three snake cayes; West, South and Middle Snake Cayes are expected to be consolidated into one RZ with straight edges as opposed to rounded as they currently are. This would make enforcement a lot easier for our rangers as well as increase the ability of the RZ to function as it ought to. The project originally intended to include East Snake Caye in the consolidated zone; however fishers decided that extending it so far would have taken too much of their prime fishing grounds. The area around the Snake Cayes can be described as noncontiguous substrate with mud, sea grass and patch reef. Any large RZ in this area would cover most of the patch reef and sea grass beds where commercial benthic fish species thrive in this area. Eventually there had to be a compromise since the consolidation of the 3 cayes would encompass at least 20% of new prime benthic fishing grounds being converted into RZ in this area. The area between the Snake Cayes and the middle cayes range is mostly mud substrate so even if the RZ were extended to include these areas the effect would not be significant in replenishing the General Use Zone (GUZ).

Subsequent to the consolidation of the RZs, new ways of increasing the RZs in PHMR were proposed to include additional ecosystems after recommendations from TNC's MARXAN analysis. Essentially, a rotational Replenishment Zones for the reserve is proposed, where areas that are closed for extraction could be open for fishing after some time while simultaneously closing other areas for a period of time to allow replenishment. This proposal will have to be shared with the stakeholders to get their feedback and input into the exact design before rolling out. It is estimated that this process will take about 2 years to complete.

b. Framework for PHMR RZ expansion

The framework for expansion of PHMR's RZ is in alignment with the Fisheries Department National Replenishment Zone expansion initiative. The objectives of the national RZ expansion are;

- National goal to increase RZ protection to incorporate 10% of all ecosystem types within Belize's territorial seas as replenishment zones incorporating stakeholder input, sound scientific evidence and use of marine management tools (such as Marxan analysis) demonstrated to have worked well elsewhere.
- Feedback from professionally mediated stakeholder consultations, including Managed Access Fishers, Sports Fishing operators and tour guides to ensure that needs of all livelihood options are being considered.
- Local Ecological Knowledge gathered through multiple formal and informal consultations with fishers from recent years.
- Scientific information on:
    - Marxan based recommendations from TNC
    - Endangered species, e.g. manatee and goliath grouper – research projects on these are taking place in 2014
    - Commercial species population health – conch, lobster, sea cucumber, finfish
    - Habitat mapping information from remote sensing and ground truthing.
    - Marine and riverine water quality.
    - Fishing activity of Managed Access licensed fishers.
- Resistance to change among stakeholders concerned about the livelihood impacts of expansion of conventional RZs. To address this, an incremental approach to implementation of new replenishment zones is recommended, with new types of restricted zones introduced to reach the national goal of 10%.

Overall the proposed strategy would bring the total area under enhanced protection to 15% of PHMR. Special Management Zones (Manatee & Goliath Grouper Special Management Zones,

Protected Wetlands Sport Fishing Zone and Zone 4 (see map Appendix 1) as a no fin-fishing zone and one of the rotating zones as sport fishing zone) would make an additional 17 % of PHMR. In all, this would make 32% of PHMR under some form of elevated protection.

Based on the results of TNC's Marxan analysis, which incorporated various types of national level ecological data identifying areas of critical habitat most important to protect in order to maintain ecosystem resilience and connectivity some recommendations were made for the

PHMR. These were presented to the co-managers of the reserve, TIDE, to incorporate feedback from those with local knowledge of the reserve, and to enable them to consider ecologically based

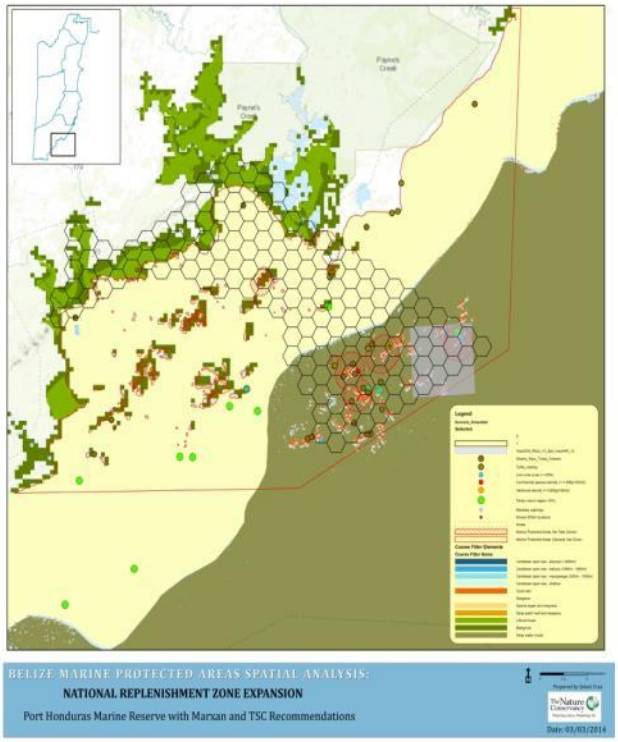


Figure 1. Recommendations of TNC's national level MARXAN analysis, prior to TIDE feedback based on local ecological knowledge and management recommendations.

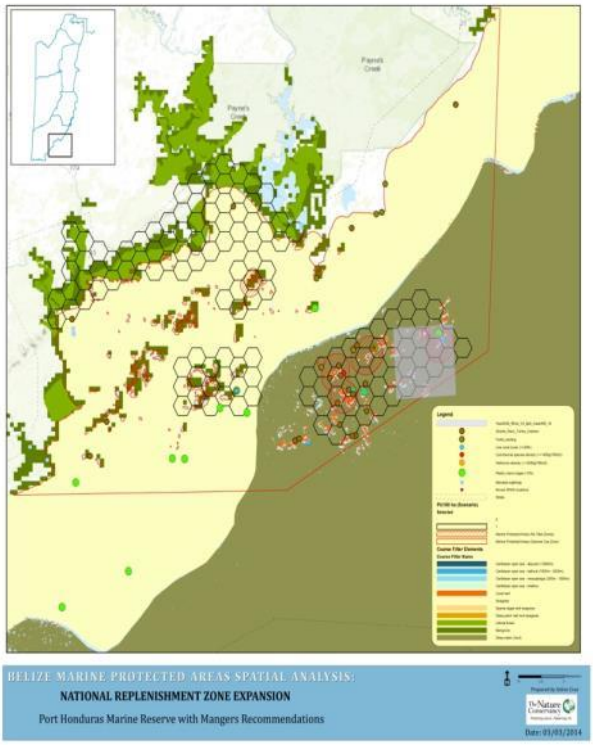


Figure 2. Revised MARXAN recommendations after incorporations of local ecological knowledge and management recommendations from TIDE

recommendations from this high powered spatial management tool in the design process. Subsequently, based on recommendations from the local managers a revised map was produced for expansion of RZs in PHMR.

Aside from designation of special management zones in the reserve, the USAID regional program working with local partnerships determine that many fishers are reluctant to accept large areas of PHMR as being under RZ protection due to the perceived permanence of this action.

Fishers seem to be more willing to support inclusion of RZs under a rotating system and have long discussed this possibility. In this approach, four zones of equal size would rotate every 3-5 years (time span to be determined with consultations, best available science and contemporary MPA theory). In each cycle, two of these areas would be under full RZ protection (including no sport fishing due to sports fishers having been given exclusive access to TIDE Private Wetlands sport fishing zone), one designated as a sport fishing zone (no fee to sport fish in contrast to TIDE private wetlands sport fishing zone, lobster and conch allowed, sport fishing allowed but not commercial fin-fishing), and the other as an open zone (General Use). This approach is not new but has never been successfully implemented in Belize. For this to be effective rigorous monitoring and enforcement must be done.

Effectiveness at achieving fisheries sustainability objectives of the rotating RZs would be monitored via population surveys by co-managers research team of commercial species (conch, lobster, sea cucumber, finfish) and sport fish species (snook, permit, tarpon, bonefish). Regular commercial species underwater surveys conducted, as well as managed access catch log data could serve to monitor replenishment effectiveness in closed zones. It is anticipated that commercial fishers and sport fishers alike would experience increases in catch in open zones due to large areas being RZs, with excellent catches once closed zones open again. While commercial species in previously closed zones would be catchable after zones open, a 3-5 year rotation cycle would permit species to regenerate for a long time before being fished again, and during closed periods there would be significant spill over from these large RZs into neighboring general use areas, with potential to support current fishing pressure and possibly sustain an increase in fishing pressure in future. Monitoring and evaluation would be required before advocating any increase in fishing pressure, but this would garner support from commercial and sports fishers. It is also very important to control fish mortality once the RZs are open to ensure there is not a rush to fish leading to rapid depletion of stocks. Below is a map of the proposed rotating RZs. As noticeable this is also based on the results of the Marxan analysis done by TNC for PHMR.

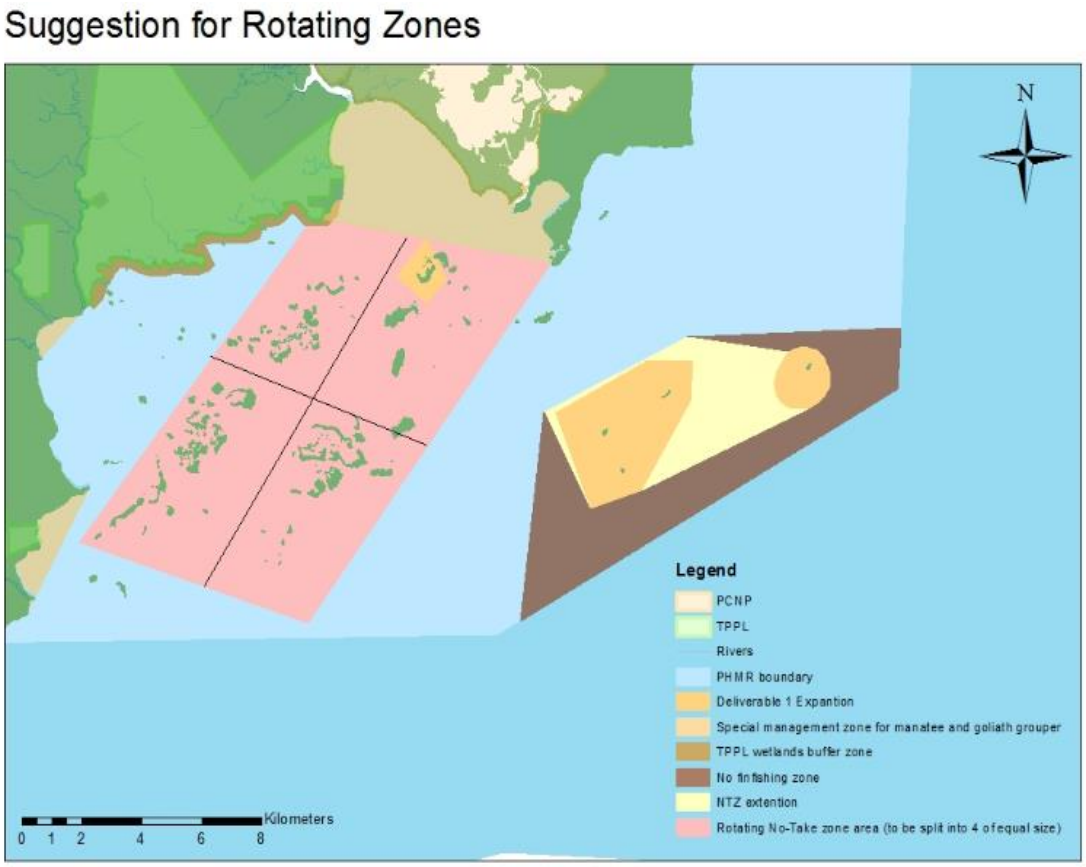


Figure 3. Approximate divisions of the four proposed rotating replenishment zones (dimensions to be guided by structured consultations), if the connectivity studies support ecosystem connectivity between Deep River area and Inner ranges of PHMR cayes. These could rotate on a 3-5 year basis (consultations), with two no take zones, one sport fishing zone and one open zone (general use) in any given rotation cycle. The four rotating zones would be equal in size, so that % under RZ status would not fluctuate from cycle to cycle.

c. Economic Diversification Sea weed farm project

It is proposed that there be Economic Diversification Zones in PHMR where sustainable livelihood diversification projects can be piloted. These could include practices such as conch nurseries, caged fish farms etc. The seaweed farming project funded through Regional USAID MAREA is being piloted by TIDE as a first step towards economic diversification zoning. Ongoing and planned projects such as the 2014 habitat mapping survey will help to inform the suitability and locations of these diversification options. It is hoped that by producing alternative livelihoods and training to fishermen, new sustainable livelihoods that allow fisher folk to maintain cultural connections to the sea can endure. This would reduce failure of alternative livelihood initiatives

because the alternatives would be activities in which fishers can use their local fisher folk knowledge.

The current seaweed farming project was conceptualized by fishers in Punta Gorda Town after learning about the successes that the Placencia Producers Cooperative (PPC) has had over the past couple of years that was supported also by the Regional USAID Program MAREA. There were organized visits by the PPC to the fishers in Punta Gorda and to PHMR to try to determine whether this seaweed farming could actually work in PHMR. After a few visits by the PPC and the Belize Fisheries Department it was determine that the seaweed species Euchema isiforme has the ability to grow well in the waters of PHMR and plans were made to have the PPC train some fishers of Punta Gorda on the planting techniques as well as plant husbandry. Materials, supplies and seaweed starting stock were purchased and transported to PHMR and along with the fishers established 3 plots in the proposed economic diversification zone of PHMR. The 3 seaweed plots each measuring 50 meters by 50 meters (250m2) were placed in clear shallow waters behind some cayes to shelter it from extreme turbulent seas. The four corners of the 50m x 50m plots were anchored with concrete footings and 8 buoys were placed around the perimeter of each plot to demarcate the area. Within the 50 meters, ropes were suspended every 10ft stretched from one end to the other. Seaweed stocks were weaved into the ropes at 1ft apart along the entire length of the ropes (Figure 4).

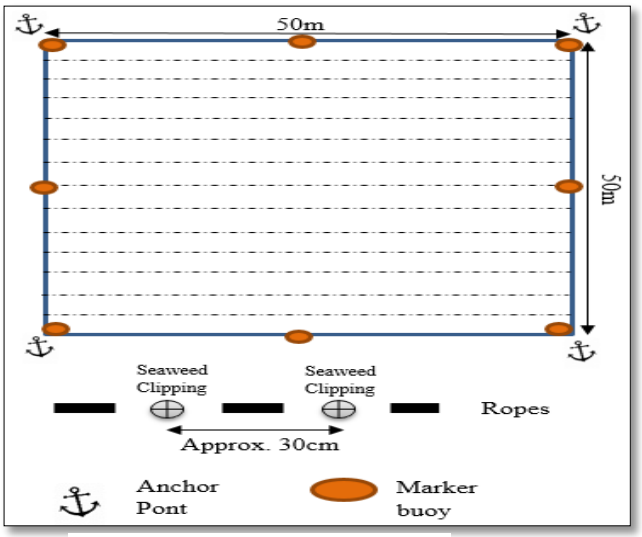


Figure 4 Diagram of seaweed plot

The overall purpose of the pilot seaweed project is to determine if the waters of PHMR is suitable to grow seaweed in commercial volume. Since planted, the sea weed has been cleaned and well taken care of by the fishers and the first harvest is expected at the end of June 2014 if growth is as expected. It will then be processed and sold to Placencia Producers Cooperative as dried seaweed. Seaweed will be harvested every 3 months or 4 times per year leaving the seaweed stock that is weaved into the rope to grow again yielding another harvestable stock every 3 months.

Based on yields from the farms in Placencia, a farm measuring 50m x 50m yields 900lbs of wet or 'raw' seaweed. This 'raw' seaweed has to be dried before the Placencia Cooperative will buy. According to the cooperative, there is a ratio of 6:1 for raw seaweed to dried product meaning after that 900 lbs of seaweed is dried it will yield 150lbs. Therefore each plot will yield 600lbs of dried seaweed per year. There hasn't been an agreed purchasing price for the seaweed as yet; however, the cooperative are prepared to purchase the dried seaweed at $18 - $20 per pound. Using the lower return on investment each plot would generate a gross income of $2,700 every 3 months. On an annual basis, each plot would earn a total gross income of $10,800. The cost of establishing one plot is $3,500 including all materials supplies and starting seaweed stock. The cost of setting up a drying facility for the seaweed is estimated at $675/plot and the cost of drying the seaweed is estimated at $800/year per plot in labor. Maintenance cost is estimated at $3,484 per year ($67/week/plot) to clean the seaweed, ropes and buoys for each plot. Based on this; profits from each plot for year 1 are estimated at $2,341. For the 3 plots, annual profits for year 1 are estimated at $7,023. After year 1 the annual profit would be $6,516 per plot or $19,548 for 3 plots. Currently there are 15 fishers involved in the project so that means each fisher would be earning a total of $468.20 for year 1 and $1,303.20 annually thereafter from the 3 plots. For this venture to have a significant income, each fisher would have to own a minimum of 2 plots measuring 50x50m or sell not less than 1,200 lbs of dried seaweed.

Based on communications from the Placencia Cooperative, they will be developing a purchase agreement with the fishers of Punta Gorda for the seaweed. The cooperative has also established a market in the United States that they will be selling seaweed to later this year. There seems to be bright future for seaweed in Belize so it is almost guaranteed that after the end of this project, the fishers will continue to profit from this venture.

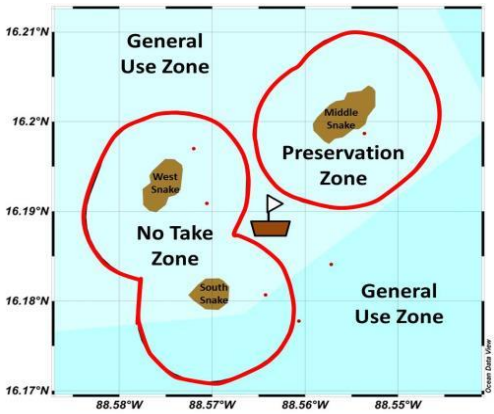
An agreement will be drafted with the fishers involved that would stipulate how the profits will be spent to ensure funds are available for maintenance of the plots. It is also of interest to start a revolving fund for fishers who are involved in supplemental livelihood programs to ensure financial sustainability of these business enterprises.

d. Consultation and fisher engagement process

i. Replenishment zone consultation

Five public consultation meetings were held with stakeholders in Monkey River, Punta Negra and Punta Gorda communities between 14th Jan and 21st Mar 2013. Seleem Chan, MPA manager, explained the purpose and benefits of replenishment zones. James Foley, science director, presented results on the health of conch and lobster stocks in PHMR, which suggest current replenishment zones are sub-optimal. Various options for replenishment zones were presented based on knowledge of habitat locations which showed how the current replenishment zones present a challenge for enforcement since it can be difficult for rangers to tell whether or not fishers are within a replenishment zone. This is because the current boundaries are circular, making it difficult to tell exactly where they lie and due to the presence of narrow gaps between some replenishment zones.

Stakeholders were given space to voice their questions and concerns then draw their preferred designs for the expanded replenishment zones on bathymetric maps of the marine reserve that show the location of underwater banks, important for fishing.



Current RZ with circular boundaries

In addition to the public meetings, a number of targeted informal meetings took place with key opinion leaders to build support. Since some stakeholders voiced that they were uncomfortable with drawing lines on maps and preferred to demarcate the new boundaries on the water, a field trip with key stakeholders was organized. On 22nd May 2013, representatives of the Rio Grande Fishermen Cooperative, Toledo Fishermen Association, Toledo Tour Guide Association, Toledo Fishermen Alliance, Punta Negra Village, Belize Fisheries Department, The Nature Conservancy and TIDE conducted a trip into the proposed replenishment area. GPS coordinates were recorded of the areas they agreed that would be in the consolidated RZ. The agreed upon areas were mapped and the maps were presented to the stakeholders.

Figure 5. Fishers drawing lines for proposed RZ during a consultation meeting

Once all the meetings had taken place, the meeting minutes, maps drawn by stakeholders and GPS coordinates were reviewed and a map developed of the newly expanded replenishment zones. The proposal for the expansion has been shared with the fisheries administrator and the senior MPA manager at the Fisheries Department. They have agreed and invited TIDE to submit this proposal along with any other recommendations for revisions to the statutory instrument for PHMR in August 2013.

Based on the proposed RZ, the area of PHMR under full protection will increase from 3.2% at present to 4.2%. Although the initial baseline of 3.2% is less than the 5% that had been thought, and although an increase to 4.2% is much less than the 15% originally proposed, this is a significant step forward. One reason to consider this a success is that the 1% increase is in the best possible locations, covering the most ecologically valuable coral reefs and probably the most important habitat for protecting fisheries. The new zones will cover an estimated 15% of the productive conch and lobster habitat.

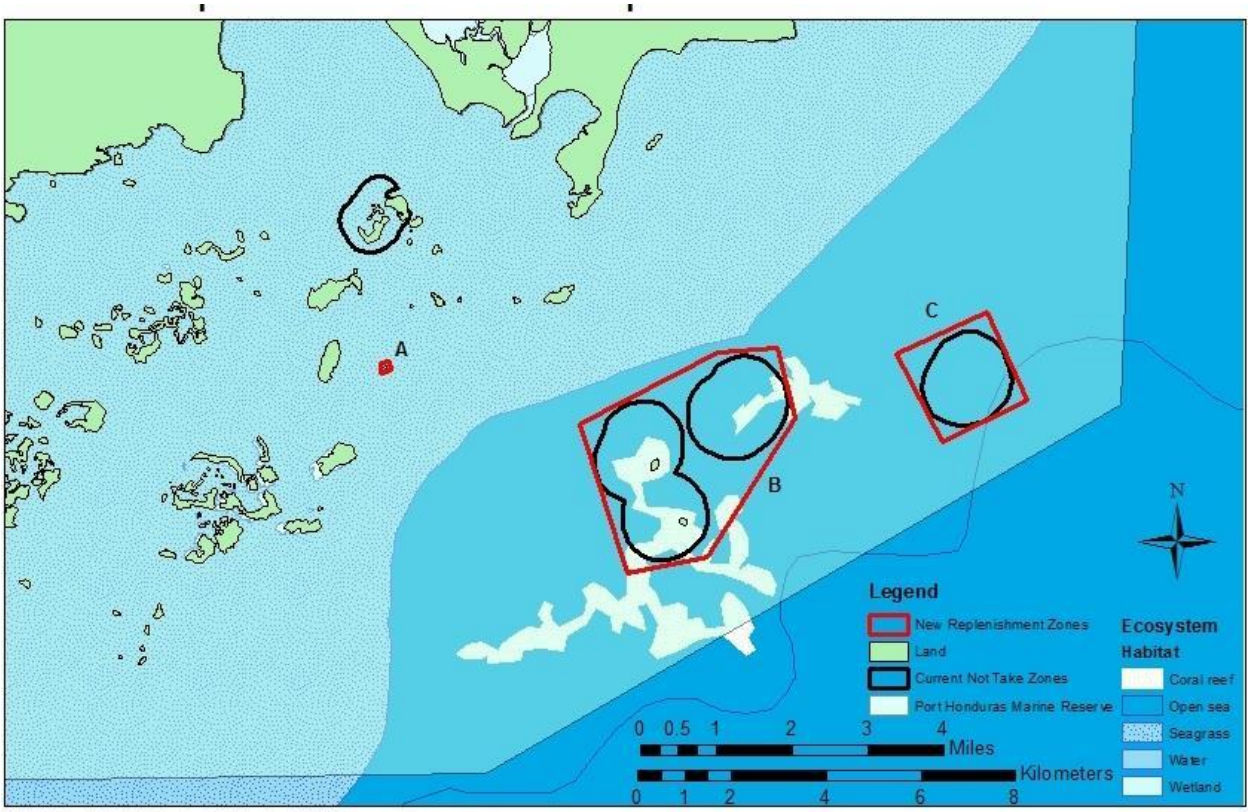


Figure 7. Existing (Black circles) and proposed (Red lines) RZs in PHMR

Noteworthy is the fact that stakeholders led the design of new replenishment zones in a highly participatory process. The fact that fishers were consulted in determining the location of new boundaries should result in much better compliance and has already helped build trust. A high degree of participation in meetings and the fact that fishers gave up profitable fishing grounds willingly are testament to the gradually increasing trust and understanding between the PHMR managers and fishers.

The Fisheries Department also supports this decision. Despite that national goal of 10% of MPAs under full protection, the Fisheries Department respected the results of the stakeholder consultations, which they participated in, again showing fishers that their opinions are listened to and helping to build trust. Enclosing West, South and Middle Snake Caye in one replenishment zone is a major success. The shape of the new replenishment zones, combined with installation of demarcation buoys, will make enforcement much easier. Having 4% of the MPA under full protection with buy-in from the fishing community and designed to facilitate enforcement and cover key habitats will be much more valuable than 15% without buy-in or with the wrong design.

The meetings facilitated enhanced mutual understanding of PHMR's ecology. There has been continued work to improve communication of research results with stakeholders, for example by presenting results as color-coded maps rather than graphs. This seemed to work because fishers were actively engaged, asking good questions during the science director's talks. Some fishers stated that they felkt confident in the research results due to their own sons and daughters involvement in collecting the data. These young people are TIDE Community Researchers. Fishers demonstrated that they understood the theory of replenishment zones and that they had listened to and bought into the benefits to a significant extent.

ii. Future RZ consultations

Stakeholder Engagement through Formal Mediation - Adaptive management is not only a scientific process but also a social one. The efficacy of replenishment zones will depend greatly upon the level of buy-in from resource users and their compliance with the regulations. In an attempt to secure buy-in from the fishing community, it is proposed to use formal mediation to engage stakeholders on the issue of replenishment zone expansion. The goal of formal mediation is to structure a conversation between stakeholders in a manner that allows all stakeholders to have equal input towards future management decisions, without dominant speakers monopolizing dialogue and decision making, and without meeker stakeholders being prevented from communicating their equally valid opinions and ideas (due to intimidation or shyness) for incorporation into the design process. A professional mediator serves to keep the conversation focused and directed. The goal of employing mediation in natural resources management is not only to reach a compromise in which all stakeholders are satisfied with the outcome, but also to foster a better working relationship among those who have an interest in the management of an important natural area.

To achieve these goals, it is intended to conduct a stakeholder analysis of PHMR to broaden and diversify the stakeholder base beyond commercial and sport fishers, as it is recognized that other divisions within the community have not historically been given an opportunity to be involved and influence decision-making relating to PHMR management. It is proposed that a series of innovative, interactive workshops be held with old and newly identified stakeholder groups from the three buffer communities of PHMR (Punta Gorda, Monkey River and Punta

Negra) as well as watershed communities located in freshwater catchment areas that drain into PHMR. The goal of these initial workshops would explicitly be to NOT attempt to tackle the real life zoning issues of PHMR, but to familiarize stakeholders with new zoning concepts, and to play interactive "games" and stakeholder roleplaying exercises designed to provide attendees with the experience of looking at coastal management issues from other points of view and negotiate with other interest groups in a mock setting. By having fun, people learn to respect, listen to and consider needs of other stakeholders. Only in later workshops would the real life issues be brought to the table in a professionally mediated setting, once people are familiar with the new zoning concepts and have had the opportunity to experience the challenges and benefits of effective stakeholder engagement to arrive at decisions that are as equitable as possible to all.

It is proposed that in later consultations, an impartial, third-party mediator be contracted to facilitate later negotiation sessions with the stakeholders who will be impacted by the future management of PHMR. This would be a novel approach not only for PHMR but also for the wider Caribbean. Of 21 Caribbean MPAs surveyed in 2009, none had used a formal conflict resolution mechanism (Gombos et al. 2011). By pioneering this innovative approach and sharing lessons via a network of Caribbean MPA, the Regional USAID program could potentially improve outcomes for MPA management region-wide.

iii. Economic diversification consultation process

During the RZ consultations it was identified that only a few fishers would have been directly impacted by the consolidation of the current RZs. These fishers were willing to give up some of their fishing grounds but felt that they should be compensated in some way. After several consultation meetings with them, it was agreed that the USAID MAREA program would pilot a seaweed farming project involving these fishers in PHMR to supplement their income. A feasibility assessment was conducted to determine the if the project would be successful in PHMR. Several meetings were also held with the Placencia Producers Cooperative that has been involved in seaweed farming for the past couple of years through the USAID MAREA program. The idea was to increase our knowledge of seaweed farming including its benefits and disadvantages.

After the consultation meetings with targeted fishers an application form was developed to select the fifteen participants needed for the sea weed pilot project. This was done in close collaboration with Mr. Armando Ramirez, Chairman of Rio Grande Fisherman's Cooperative, Mr. Martin Reyes, Chairman of Toledo Fishermen's Association, and Mr. Dennis Usher, Chairman of Southern Fisher-folk Alliance.

In the initial stages of the project, several planning meetings were held.. At these meetings the fishers' representatives got the opportunity to contribute to the design of the application form. Copies of the form were provided to them, in an attempt to recruit possible participants.

Completed application forms were then submitted to the project coordinator. A meeting was then held to select possible participants.

It was agreed that an important criteria is that all participants must be Managed Access licensees of Port Honduras Marine Reserve. They must own or have access to a boat, must visit the reserve at least once per week and must be committed to the success of the project.

6. CONCLUSION AND RECOMMENDATIONS

a. Conclusion and recommendations for RZ expansion

After all the consultations and meetings it was agreed that 3 of the 5 segregated RZs in PHMR will be consolidated and their boundaries straightened. The consolidation of these 3 zones increased the overall RZ by 1% for a total of 4.3% of PHMR under no-extraction status. As indicated, although this is a small increase the area now under no extraction status are considered prime benthic fishing grounds with the ability to replenish the general use zone in the immediate area.

In an effort to align our efforts with the national goal of increasing RZs in Belize to 10% of MPAs, it is proposed to use the innovative integrated approach using technical intervention during the consultations to get stakeholders to agree to rotating RZs, special management areas for manatees and goliath groupers and an exclusive sports fishing zone that would have at least 32% of the reserve under some form of protection at any given time. These recommendations and others are listed below;

- **Implement rotating replenishment zones in PHMR** whereby four zones of equal size would rotate every 3-5 years (time span to be determined with consultations, best available science and contemporary MPA theory). In each cycle, two of these areas would be under full RZ protection (including no sport fishing due to sports fishers having been given exclusive access to TIDE Private Wetlands sport fishing zone), one designated as a sport fishing zone (no fee to sport fish in contrast to TIDE private wetlands sport fishing zone, lobster and conch allowed, sport fishing allowed but not commercial fin-fishing), and the other as an open zone (General Use).
- **Develop and implement a rigorous scientific monitoring program** for commercial species (conch, lobster, sea cucumber, fin fish) and sport fish species (snook, permit, tarpon, bonefish). Regular commercial species underwater surveys conducted, as well as managed access catch log data could serve to monitor replenishment effectiveness in closed zones. It is anticipated that commercial fishers and sport fishers alike would experience increases in catch in open zones due to large areas being RZs, with excellent catches once closed zones open again. While commercial species in

previously closed zones would be catchable after zones open, a 3-5 year rotation cycle would permit species to regenerate for a long time before being fished again, and during closed periods there would be significant spill over from these large RZs into neighboring general use areas, with potential to support current fishing pressure and possibly sustain an increase in fishing pressure in future. Monitoring and evaluation would be required before advocating any increase in fishing pressure, but this would garner support from commercial and sports fishers.

- **Improve current enforcement program** through the use of hi-tech means such as SMART and unmanned drones that are currently being tested by the Fisheries Department and Wildlife Conservation Society in Belize.
- **Conduct a genetic connectivity study** as a means to obtain high quality interconnectivity information, depending on the outcome of the sport fish tagging study. This ecological corridor may not only be more important in terms of preserving ecosystem connectivity, but may be a more popular idea with fishers than increasing RZ size around the Snake Cayes. Further professionally mediated consultations are necessary to move forward with this proposed strategy outlined in the stakeholder consultation section of the Introduction to this report.

b. Conclusion and recommendations for economic diversity program

The seaweed farming project in PHMR has thus far proven to be successful for a number of reasons. Firstly, there is full buy-in from the Fisheries Department and the targeted fishers for the project. Secondly, the USAID MAREA program and their partnership with The Nature Conservancy secured the project financially and technically. In addition, the environmental conditions necessary for farming seaweed in PHMR were available and fishers participated in all levels of the process. The PHMR fishers now have an established partnership with the Placencia Producers Cooperative during the implementation of this project as they did the training of the fishers as well as provided the seaweed starting stock. Fishers drafted a plan to maintain the seaweed farms on a weekly basis where they would clean once a week and TIDE would also clean on a rotational basis. Farms require cleaning because during this time of year there are strong wave actions that suspend sediments that get settled on the seaweed. This sediment needs to be cleaned weekly to ensure healthy seaweed. The placencia Producers Cooperative has committed to purchasing the dried seaweed from this project for $18-$20 per pound. A total of 15 fishers have signed on for the project and 3 seaweed plots were established. These 3 plots at full production will earn $19,548 per year after expenses starting in year 2. The fishers involved in this project would have to decide how this profit will be distributed or reinvested. Based on the figures and experience the following recommendations are made;

- Fishers that are currently participating in the seaweed project should consider forming a group to better manage the farms and earn more income.
- A mentor is needed to work with the fishers to help with managing the project and train fishers in basic small business management. This should be done as soon as possible to ensure the project doesn't fail after year 1 since the profits for year 1 is smaller than the full potential after year 2. In addition, it is important that fishers use the profits to reinvest in the project to expand the farm in order for it to be a viable source of income. As stated, each fisher need to sell not less than $1,200 lbs of dried seaweed at $18/lb for it to be profitable.

- Establishment of Economic Diversification Zones in PHMR where sustainable livelihood diversification projects can be piloted. These could include practices such as conch nurseries, caged fish farms etc., including the current seaweed farms. Ongoing and planned projects such as the 2014 habitat mapping survey will help to inform the suitability and locations of these diversification options. It is hoped that by producing alternative livelihoods and training to fishermen, new sustainable livelihoods that allow fisher folks to maintain cultural connections to the sea can endure. This would reduce failure of alternative livelihood initiatives because the alternatives would be activities in which fishers can use their local knowledge.
- the possibility of installing sea cucumbers farming within the sea weed farms to increase the possible income that can be generated from the same area should be further resdearched.
- There needs to be meetings with tour guides who are concerned that the seaweed farms can possibly affect sports fishing activities.

c. Update on seaweed harvesting.

As at the date of this report, the seaweed planted in this project is at its harvesting stage. Fishers travelled into the reserve to harvest seaweed that was planted three months ago. On two separate trips to the farms the group harvested approximately 50 pounds of wet sea weed. The sea weed was then washed and rinsed with fresh water to remove the salt. After this process was complete, the wet sea weed was placed on two drying stands that were previously prepared by the fishers.

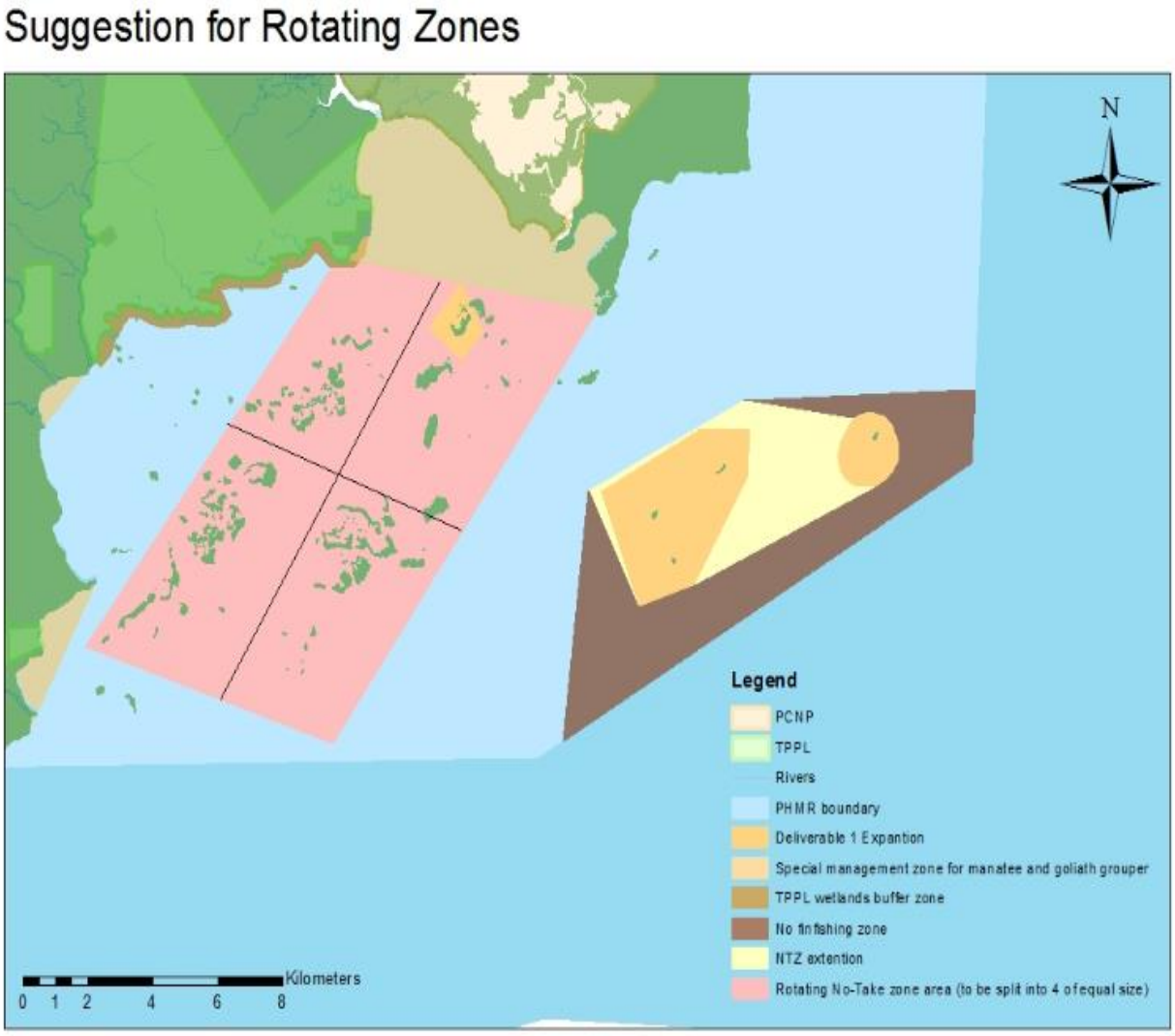
The fishers then hoped for three (3) constant days of sun. The heat from the sun will dry the sea weed, which will then be ready to be sold to the cooperative in Placencia Village. Unfortunately, the seaweed has received just over a day and a half of sun and still needs to complete its drying process. It is presently raining a lot at this time, making it impossible to complete the drying process. The fishers are eagerly waiting for the sun to resurface so that the drying process can be completed. Based on the ratio of wet to dry seaweed (6:1) a little over 8 lbs of dried seaweed will be collected and sold to the PPC.

Prior to harvesting of the seaweed, the group of fishers working on the sea weed pilot project discovered that two lengths of ropes (50 meters each) filled with seaweed were missing from one of the plots. It is estimated that a total of 40 – 50 pounds of wet seaweed were stolen from the farm; no one was found with the seaweed. As a result of this incident, the fishers decided to relocate five ropes, with the intent to later relocate the entire four farms to a safer location where they can be monitored by the fishers themselves.

Figure 8 Harvested seaweed being dried

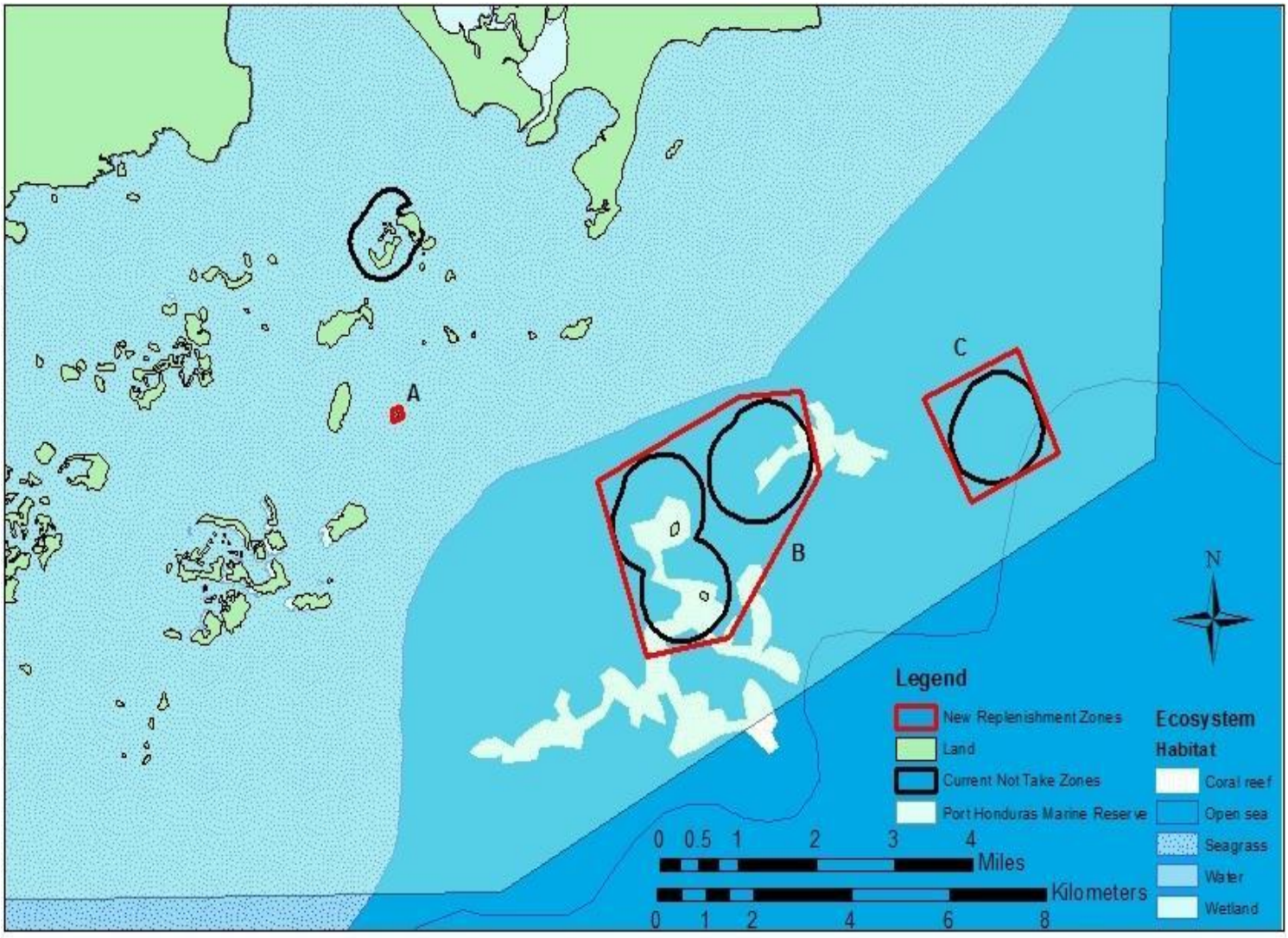
7. ANNEXES

a. Map of proposed 32% PHMR RZ expansion



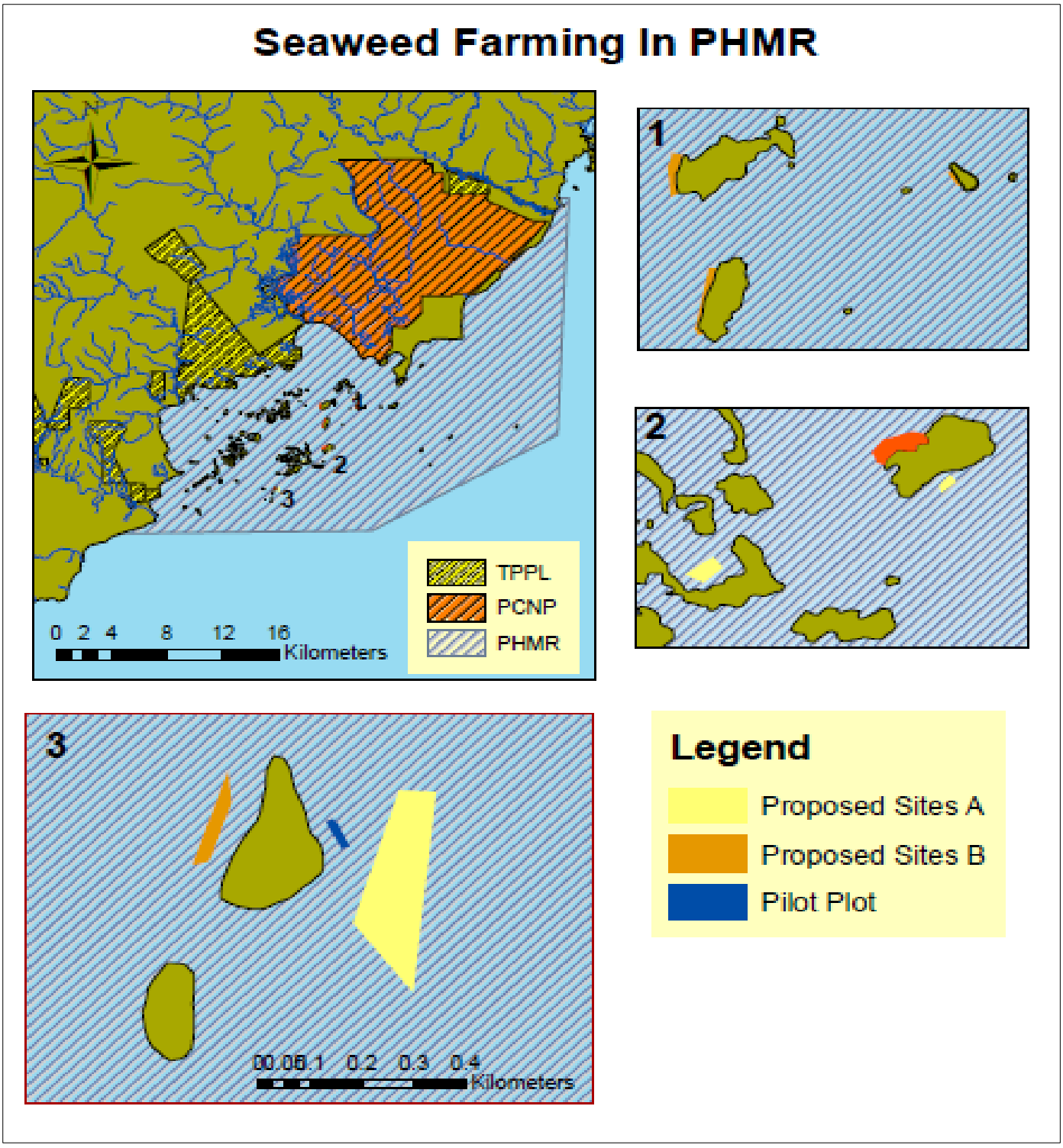
Approximate divisions of the four proposed rotating replenishment zones (dimensions to be guided by structured consultations), if the connectivity studies support ecosystem connectivity between Deep River area and Inner ranges of PHMR cayes. These could rotate on a 3-5 year basis (consultations), with two no take zones, one sport fishing zone and one open zone (general use) in any given rotation cycle. The four rotating zones would be equal in size, so that % under RZ status would not fluctuate from cycle to cycle.

b. Map of proposed PHMR consolidation of present RZs



Existing (Black circles) and proposed (Red lines) RZs in PHMR

c. Map of location area for sea-weed farm



d. Copy of draft Statutory Instrument for the consolidated RZ

Currently, there are five RZ in PHMR, each extending half a mile radius from one caye (Figure 1). Four of the zones are open to tourism (conservation zones) while one is completely off limits except for research and emergency rescue (preservation zone). Together, these zones cover 1300 ha, or 3.2% of the area of PHMR.

DIGITAL MAP OF PROPOSED RZ CONSOLIDATION

The proposed RZ are shown in Figure 5 and described as follows:

South, West and Middle Snake Caye: The current no-take zone around South Snake Caye, West Snake Caye, and preservation zone around Middle Snake are proposed to be adjoined by a hexagon. This will encompass a bank north of Middle Snake Caye, portion of a bank found on the southeastern side of Middle Snake Caye and portion of a bank on the southeastern side of South Snake Caye. In addition, one bank on the west side of West Snake Caye was enclosed. Having the boundaries on a bank will aid the placement of demarcation buoys.

The area around Middle Snake Caye will remain a preservation zone. Again with the aim to aid demarcation, it is suggested that a straight line is used to separate the preservation from the no-take zone rather than using the old boundary of the preservation zone (currently a circle). This will increase the zone of the preservation zone marginally. The boundary is not arbitrary but encompasses areas thought to be critical conch and lobster nursery and spawning habitat in order to enhance the replenishment function of the RZ.

East Snake and Wild Cane Caye: Within the old SI a half mile radius around East and Wild Cane Caye is used to generate the boundary of the no-take zone, also scaling a set of 4 coordinates.

After investigation of the current enforced area it was found that the most accurate representation of the no-take zone at East Snake Caye was to use files from BERDS opposed to the original SI. In future proposals it is hoped that the boundary surrounding East Snake can be altered into a square to aid demarcation however this will require further consultation with fishers.

In the case of Wild Cane Caye it was also found that the BERDS border was being enforced as opposed to what is in the SI. Therefore it is proposed that the coordinates in the proposed SI are altered to match with this border. In addition it is suggested that the shape of the boundary is altered to a rectangle shape to aid demarcation. This alteration will have little influence over the area covered by the current enforced no-take zone however will result in some areas that were under protection no longer being protected, and other areas that were not under protection now being within the new shape.

Annex 1 documents the new coordinates to fit with these alterations.

Calculations (ha) for preservation expansion

	BERDS (old)	Proposed SI (new)

Preservation Zone, West and Middle Snake Cayes	869	1308
East Snake Caye	287	287
Wild Cane Caye	143	163
TOTAL	1299	1758
PERCENTAGE COVER	**3.2**	**4.4**

The proposed expansion to encompass Middle, South and West Snake Cays as one area will increase the no-take zone of PHMR from 3.2% to 4.4%. An increase in no-take area of 1.1%.

NOTE: Terrestrial areas (cayes) are removed from calculations.

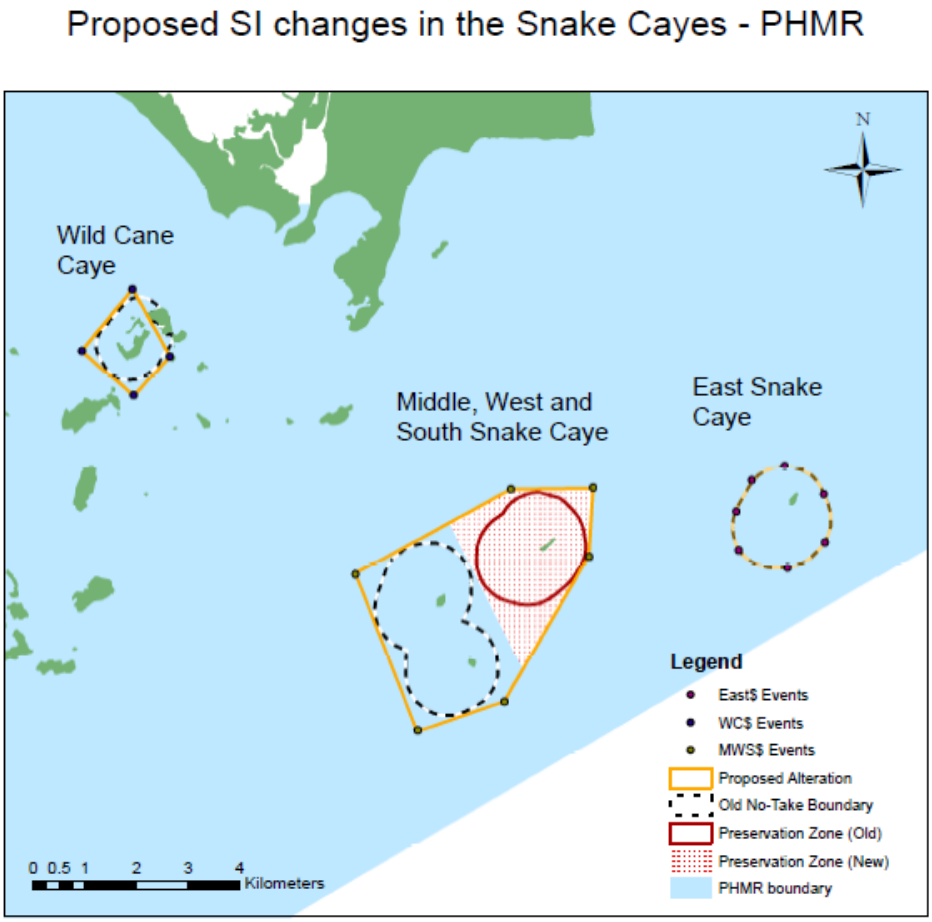


Figure 5: Proposed expansion of PHMR replenishment zone. The old boundary is represented by BERDS perceived boundary (http://www.biodiversity.bz/mapping/warehouse/). Proposed coordinates to mark the proposed boundaries are documented in Annex 1.

JUSTIFICATION / CRITERIA USED FOR THE CONSOLIDATION OF THREE OF PHMR'S EXISTING RZ INTO ONE AREA

The encapsulation of West, South and Middle Snake Caye into one area has been proposed for several reasons, as follows:

i) It will close off a narrow gap between the existing RZ, making enforcement easier;
ii) The straight boundaries will make enforcement easier;
iii) The new boundary encompasses submerged banks thought to be critical nursery and spawning habitat for conch and lobster;
iv) The underwater banks protected by the new design are contiguous with banks outside of the proposed RZ, theoretically resulting in spill over of adult lobster and conch from the RZ into adjacent general use zone areas.

This is the primary area used by lobster and conch fishers in PHMR and is reported to be extremely productive. Hence, it was very difficult to secure fishers' consent for the expansion here. Nevertheless, fishers did agree to the expansion because they understand the benefits of the spillover effect and because they believe that TIDE can effectively enforce the proposed RZ. There was some skepticism regarding the ability to prevent illegal extraction by trans-boundary fishers in a larger RZ.

Proposed coordinates for Statutory Instrument - Expansion of Replenishment Zones

East Snake Caye Conservation Zone

Area scaling the following coordinates:

- 338625 East 1793306 North
- 339379 East 1792751 North
- 339406 East 1791825 North
- 338678 East 1791322 North
- 337739 East 1791679 North
- 337686 East 1792420 North
- 337990 East 1793015 North

Area: 287 ha

Wild Cane Caye Conservation Zone

Area: 163 ha

Commencing at a **Point A** lying North of Wild Cane Caye having scaled UTM coordinates 326005 East and 1796701 North; thence in a general south-easterly direction 1473 Meters to a **Point B**

having scaled UTM coordinates 326727 East 1795420 North; thence in a general south-westerly direction 1035 Meters miles to a **Point C** having scaled UTM coordinates 326026 East 1794659 North; thence in a general north-westernly direction 1326 Meterss to a **Point D** having scaled UTM coordinates 325026 East 1795529 North; thence in a general northern-easterly direction 1527 Meters back to the point of commencement.

West, South, and Middle Snake Caye

Area: 1308 ha

Commencing at a **Point A** lying West of West Snake Caye having scaled UTM coordinates 330322 East 1791201 North; thence in a general north- easterly direction 3441 Meters to a **Point B** having scaled UTM coordinates 333326 East 1792840 North; thence in a easterly direction 1587 Meters to a **Point C** having scaled UTM coordinates 334913 East 1792872 North; thence in a general south,south-westerly direction 1320 Meters to a **Point D** having scaled UTM coordinates 334839 East 1791554 North; thence in a general south, south-westerly direction 3251 Meters to a **Point E** having scaled UTM coordinates 333204 East 1788744 North; thence in a general west-south-westerly direction 1769 Meters to a **Point F** having scaled UTM coordinates 331522 East 1788197 North; thence in a general north-westerly direction 3235 Meters back to the point of commencement. The line bisecting the area into the RHS Preservation Zone to LHS No-take zone will run from 332180 East 1792217 North in a southerly direction for 6336 Meters to intercept the boundary line at 332180 East 1792217 North.

e. Copy of signed agreement with Fishers for further expansion aligned with National No-Take expansion.

Due to the national effort to extend the RZ of marine reserves in Belize TIDE felt that it is best to wait until that process is more advance before getting fishers to agree to the extension. In addition, the approach to extending the RZ through a rotating fashion proposed by TIDE would require a structured approach that will take some time. This will require time beyond the life of this project, but the fishers are committed to continuing the program started by USAID in the interest of the national program as well as in the interest of the marine resources. Below is a proposed timeline of this approach;

Timeline Stage	**Goal**	**Time -frame**
1) Call for mediation proposals	Get ideas/second opinion from professionals about what should be involved in the mediation process	Month 1
2) Conduct stakeholder analysis	Identify who stakeholders are to gauge scale of mediation	Month 2
3) Mock mediation process with TIDE staff	Practice stakeholder engagement techniques for TIDE staff to become familiarized with new approach	Month 2
4) Invite interest groups identified during stakeholder analysis to put forward candidates to represent them	Ensure appropriate representatives of each stakeholder group or community are included in mediation. Mock mediation process will help inform the characteristics required of the individuals selected.	Month 2
5) First full consultation - scenarios workshop	Local involvement and awareness of new mediation methodology. Role play exercises using various fictional scenarios, getting stakeholders used to seeing coastal management issues from other points of view, learning to respect and consider needs of other stakeholders besides self. Build awareness of different options for marine management in mock setting.	Month 3
6) Second consultation - Current Proposal Ideas as described in D2	Stakeholders already familiar with new engagement processes, used to considering ideas in new and constructive ways, present TIDE's ideas and encourage teams to work in groups composed of multiple stakeholder interests. Must come back to final consultations to present plan.	Month 4
7) Third consultation – present results from previous session. Work on real life PHMR scenario.	Groups present plans that have incorporated multiple points of view, and then given real life PHMR scenario with professional mediator present. Repeat procedures from second consultation with real life PHMR scenario.	Month 5-6